WHAT IS CLAIMED IS:

1. A method for three-dimensional reconstruction (3DR) of a single tubular organ using a plurality of two-dimensional images comprising:

displaying a first image of a vascular network;

receiving input for identifying on the first image a vessel of interest;

tracing the edges of the vessel of interest including eliminating false edges of objects visually adjacent to the vessel of interest;

determining substantially precise radius and densitometry values along the vessel;

displaying at least a second image of the vascular network;

receiving input for identifying on the second image the vessel of interest;

tracing the edges of the vessel of interest in the second image, including eliminating false edges of objects visually adjacent to the vessel of interest;

determining substantially precise radius and densitometry values along the vessel of interest in the second image;

determining a three dimensional reconstruction of the vessel of interest; and

determining fused area measurements along the vessel.

2. The method according to claim 1, wherein the vessel of interest is selected from the group comprising: an artery, a vein, a coronary artery, a carotid artery, a pulmonary artery, a renal artery, a hepatic artery, a femoral artery, a mesenteric artery, and any other tubular organ.

3. The method according to claim 1, further comprising determining a centerline, comprising a plurality of centerline points.

4. The method according to claim 1, wherein the fused area measurements are obtained using a fusion of diameter and cross section-densitometry derived measurements.

5. The method according to claims 1 or 4, wherein determining the fused area comprises:

determine a plurality of healthy diameters along the vessel of interest to be used as a physical reference;

normalizing a majority of the data, diameters and cross-section values to physical units, using the above physical reference; and

fusing a majority of the data into single area measurements, weighting each source of data according to the reliability of the data.

6. The method according to claim 5, where weighting is computed as a function of the views geometry and/or 3D vessel geometry.

7. The method according to claim 1, wherein the input for identifying the vessel of interest comprises of three points comprise a first point to mark the stenosis general location, a second point proximal to the stenosis, and a third point distal to the stenosis.

8. The method according to claim 1, wherein the input for identifying the vessel of interest comprises markers for two (2) points for at least one of the first and second images, wherein one of the two points is anywhere proximal to the stenosis and the other point is anywhere distal to the stenosis.

9. The method according to claim 1, wherein the markers comprise two (2) points for the first image and one (1) point for the second image, wherein one of the two points is anywhere proximal to the stenosis and the other point is anywhere distal to the stenosis and wherein one point is an anchor point identified automatically on the first image.

10. The method according to claim 1, wherein elimination of false edges comprises ignoring one or more bubbles adjacent the vessel of interest.

11. The method according to claim 1 or 10, wherein elimination of false edges comprises:

defining a region of interest substantially parallel to a primary centerline;

detecting at least one cluster of pixel data, adjacent to the vessel of interest, wherein each cluster of pixel data having a predetermined brightness level greater than a brightness level of surrounding pixel data;

selecting an arbitrary pixel within each cluster;

selecting a second pixel provided on a lane bounding the region of interest for each arbitrary pixel of each cluster;

establishing a barrier line to define an edge for the vessel of interest by connecting a plurality of arbitrary pixels with a corresponding second pixel, wherein upon the tracing each edge of the vessel of interest, the traced edge avoids each barrier line.

12. The method according to claim 1, wherein elimination of false edges comprises detecting and/or eliminating one or more bumps along the vessel of interest.

13. The method according to claim 1 or 12, wherein elimination of false edges includes:

establishing a list of suspect points, comprising:

establishing a plurality of first distances between each of a plurality of originating points on at least one preliminary traced edge and a corresponding closest point positioned along the primary centerline;

establishing a plurality of second distances between each of a plurality of second centerline points point on the primary centerline to a corresponding closest point positioned on the at least one edge; and

determining deviation, from the centerline, an absolute distance of the second distance and the first distance;

determining a gradient cost function, inversely proportional to a gradient magnitude at each edge point;

determining a combined function aggregating deviation from the centerline and the gradient cost function, wherein upon the combined function being greater than a predefined value, the corresponding edge point is determined to be a bump point in a bump;

determining a bump area defined by a plurality of connected bump points and a cutting line adjacent the vessel of interest, wherein the cutting line comprises a line which substantially maximizes a ratio between the bump area and a power of a cutting line length; and

cutting the bump from the edge at the cutting line to establish a final edge.

14. The method according to claim 3, wherein defining a centerline of the vessel of interest comprises:

determining final traced edges of the vessel of interest;

determining pairs of anchor points, wherein each pair comprises one point on each edge;

determining a cross-sectional line by searching for pairs of anchor points which, when connected, establish the cross-sectional line substantially orthogonal to the center-line;

dividing each edge into a plurality of segments using the anchor points, wherein for each segment, correspondence between the edges is established in that every point of each edge includes at least one pair of points on an opposite edge and a total sum of distances between adjacent points is minimal; and

connecting the centers of the plurality of segments to determine the centerline.

15. The method according to claim 1, wherein determining densitometry values comprises subtracting a background influence.

16. The method according to claim 1 or 15, wherein determining densitometry values comprises:

establishing a plurality of profile lines substantially parallel to at least one edge of the vessel of interest;

establishing a parametric grid covering the vessel of interest and a neighboring region, wherein the parametric grid includes a first parameter of the vessel of interest along the length thereof and a second parameter for controlling a cross-wise change of the vessel of interest;

sampling the image using the grid to obtain a plurality of corresponding gray values, wherein:

the gray values are investigated as functions on the profile lines;

substantially eliminating detected occluding structures on the outside of the vessel of interest, the structures being detected as prominent minima of the parameters;

substantially eliminating prominent minima detected on the inside of the vessel of interest;

averaging gray values in a direction across the vessel of interest separately for each side of the vessel of interest;

determining a linear background estimation on the grid inside the vessel of interest; and

determining cross-sectional area using the eliminated prominent minima.

17. The method according to claim 1, further comprising determining healthy vessel dimensions using an iterative regression over a healthy portion of the vessel of interest.

18. The method according to claim 17, wherein each iteration comprises a compromise between a pre-defined slope and a line that follows healthy data.

19. The method according to claim 18, wherein the compromise is toward the line that follows the healthy data if the line corresponds to actual data over a plurality of clusters.

20. The method according to claim 1, further comprising displaying, either in 2D and/or in 3D, healthy vessel dimensions of the vessel of interest.

21. The method according to claim 3, wherein determining the three-dimensional reconstruction of the vessel of interest includes:

determining a conventional epi-polar distance p_1 for the plurality of centerline points in the first image;

determining a conventional epi-polar distance p_2 for the plurality of centerline points in the second image; and

re-determining p_2 substantially in accordance with $p_{2new} = p_2 + \delta$, where δ is a smooth compensatory function establishing correspondence of one or more landmark points.

22. The method according to claim 1, further comprising displaying color coded data relating to the vessel of interest in any display of data.

23. The method according to claim 1, wherein after receiving input for identifying the vessel of interest in the second image, displaying an epi-polar indicator for indicating a concurrence between the first image and second image for producing a three-dimensional reconstruction of the vessel of interest.

24. The method according to claim 1, further comprising displaying quantitative analysis of the vessel of interest including cross-section area graph and/or lesion analysis measurements.

25. The method according to claim 1, further comprising cross-referencing data among at least a pair or more data related to the two-dimensional trace of the vessel of interest, the three-dimensional reconstruction of the vessel of interest, and graphical data.

26. A system for three-dimensional reconstruction (3DR) of a single blood vessel using a plurality of two-dimensional images comprising:

a display for displaying a first image of a vascular network and a second image of a vascular network, and a three-dimensional reconstruction of a vessel;

input means for receiving input for identifying a vessel of interest on the first image and for identifying the vessel of interest on the second image;

a processor arranged to operate one or more application programs comprising computer instructions for:

tracing the edges of the vessel of interest including eliminating false edges of objects visually adjacent to the vessel of interest;

determining substantially precise radius and densitometry values along the vessel;

tracing the edges of the vessel of interest in the second image, including eliminating false edges of objects visually adjacent to the vessel of interest;

determining substantially precise radius and densitometry values along the vessel of interest in the second image;

determining a three dimensional reconstruction of the vessel of interest; and

determining fused area measurements along the vessel.

27. The system according to claim 26, wherein the vessel of interest is selected from the group comprising: an artery, a vein, a coronary artery, a carotid artery, a pulmonary artery, a renal artery, a hepatic artery, a femoral artery, and a mesenteric artery.

28. The system according to claim 26, wherein the application programs further include computer instructions for determining a centerline, comprising a plurality of centerline points.

29. The system according to claim 26, wherein the fused area measurements are obtained using a fusion of diameter and cross section-densitometry derived measurements.

30. The system according to claim 26 or 29, wherein determining the fused area comprises:

determining a plurality of healthy diameters along the vessel of interest to be used as a physical reference;

normalizing a majority of the data, diameters and cross-section values, to physical units, using the above physical reference; and

fusing a majority of the data into single area measurements, weighting each source of data according to the reliability of the data.

31. The system according to claim 30, where weighting is computed as a function of the views geometry and/or 3D vessel geometry.

32. The system according to claim 26, wherein the input for identifying the vessel of interest comprises of three points comprise a first point to mark the stenosis general location, a second point proximal to the stenosis, and a third point distal to the stenosis.

33. The system according to claim 26, wherein the input for identifying the vessel of interest comprises markers for two (2) points for at least one of the first and second images, wherein one of the two points is anywhere proximal to the stenosis and the other point is anywhere distal to the stenosis.

34. The system according to claim 26, wherein the markers comprise two (2) points for the first image and one (1) point for the second image, wherein one of the two points is anywhere proximal to the stenosis and the other point is anywhere distal to the stenosis and wherein one point is an anchor point identified automatically on the first image.

35. The system according to claim 26, wherein elimination of false edges comprises ignoring one or more bubbles adjacent the vessel of interest.

36. The system according to claim 26 or 35, wherein elimination of false edges comprises:

defining a region of interest substantially parallel to a primary centerline;

detecting at least one cluster of pixel data, adjacent to the vessel of interest, wherein each cluster of pixel data having a predetermined brightness level greater than a brightness level of surrounding pixel data;

selecting an arbitrary pixel within each cluster;

selecting a second pixel provided on a lane bounding the region of interest for each arbitrary pixel of each cluster;

establishing a barrier line to define an edge for the vessel of interest by connecting a plurality of arbitrary pixels with a corresponding second pixel, wherein upon the tracing each edge of the vessel of interest, the traced edge avoids each barrier line.

37. The system according to claim 26, wherein elimination of false edges comprises detecting and/or eliminating one or more bumps along the vessel of interest.

38. The system according to claim 26 or 37, wherein elimination of false edges includes:

establishing a list of suspect points, comprising:

establishing a plurality of first distances between each of a plurality of originating points on at least one preliminary traced edge and a corresponding closest point positioned along the primary centerline;

establishing a plurality of second distances between each of a plurality of second centerline points point on the primary centerline to a corresponding closest point positioned on the at least one edge;

determining deviation, from the centerline, an absolute distance of the second distance and the first distance;

determining a gradient cost function, inversely proportional to a gradient magnitude at each edge point;

determining a combined function aggregating deviation from the centerline and the gradient cost function, wherein upon the combined function

being greater than a predefined value, the corresponding edge point is determined to be a bump point in a bump;

determining a bump area defined by a plurality of connected bump points and a cutting line adjacent the vessel of interest, wherein the cutting line comprises a line which substantially maximizes a ratio between the bump area and a power of a cutting line length; and

cutting the bump from the edge at the cutting line to establish a final edge.

39. The system according to claim 26, wherein the application programs also include computer instructions for displaying an epi-polar indicator for indicating a concurrence between the first image and second image for producing a three-dimensional reconstruction of the vessel of interest.

40. The system according to claim 28, wherein defining a centerline of the vessel of interest comprises:

determining final traced edges of the vessel of interest;

determining pairs of anchor points, wherein each pair comprises one point on each edge;

determining a cross-sectional line by searching for pairs of anchor points which, when connected, establish the cross-sectional line substantially orthogonal to the center-line;

dividing each edge into a plurality of segments using the anchor points, wherein for each segment, correspondence between the edges is established in that every point of each edge includes at least one pair of points on an opposite edge and a total sum of distances between adjacent points is minimal; and

connecting the centers of the plurality of segments to determine the centerline.

41. The system according to claim 26, wherein determining densitometry values comprises subtracting a background influence.

42. The system according to claim 26 or 41, wherein determining densitometry values comprises:

establishing a plurality of profile lines substantially parallel to at least one edge of the vessel of interest;

establishing a parametric grid covering the vessel of interest and a neighboring region, wherein the parametric grid includes a first parameter of the vessel of interest along the length thereof and a second parameter for controlling a cross-wise change of the vessel of interest;

sampling the image using the grid to obtain a plurality of corresponding gray values, wherein:

the gray values are investigated as functions on the profile lines;

substantially eliminating detected occluding structures on the outside of the vessel of interest, the structures being detected as prominent minima of the parameters;

substantially eliminating prominent minima detected on the inside of the vessel of interest;

averaging gray values in a direction across the vessel of interest separately for each side of the vessel of interest;

determining a linear background estimation on the grid inside the vessel of interest; and

determining cross-sectional area using the eliminated prominent minima.

43. The system according to claim 26, further comprising determining healthy vessel dimensions using an iterative regression over a healthy portion of the vessel of interest.

44. The system according to claim 43, wherein each iteration comprises a compromise between a pre-defined slope and a line that follows healthy data.

45. The system according to claim 44, wherein the compromise is toward the line that follows the healthy data if the line corresponds to actual data over a plurality of clusters.

46. The system according to claim 28, wherein determining the three-dimensional reconstruction of the vessel of interest includes:

determining a conventional epi-polar distance p_1 for the plurality of centerline points in the first image;

determining a conventional epi-polar distance p_2 for the plurality of centerline points in the second image; and

re-determining p_2 substantially in accordance with $p_{2new} = p_2 + \delta$, where δ is a smooth compensatory function establishing correspondence of one or more landmark points.

47. The system according to claim 26, wherein the application programs including computer instructions for displaying color coded data relating to the vessel of interest in any display of data.

48. The system according to claim 26, further comprising epi-polar indicator means for indicating a concurrence between the first image and second image for producing a three-dimensional reconstruction of the vessel of interest.

49. The system according to claim 26, further comprising quantitative analysis means for rendering quantitative analysis of the vessel of interest including cross-section area graph and/or lesion analysis measurements.

50. The system according to claim 26, further comprising cross-referencing means for cross-referencing data among at least a pair or more data related to the two-dimensional trace of the vessel of interest, the three-dimensional reconstruction of the vessel of interest, and graphical data.

51. A system for three-dimensional reconstruction (3DR) of a single blood vessel using a plurality of two-dimensional images comprising:

display means for displaying a first image of a vascular network, and a second image of the vascular network and the 3DR;

input means for identifying a vessel of interest on the first image and the second image;

tracing means for tracing the edges of the vessel of interest in each image including elimination means for eliminating false edges of objects visually adjacent to the vessel of interest in each image;

a processor for:

determining a centerline, comprising a plurality of centerline points, determining substantially precise radius and densitometry values along the vessel, determining substantially precise radius and densitometry values along the vessel of interest in the second image, determining a three dimensional reconstruction of the vessel of interest, determining fused area (cross-section) measurements along the vessel and establishing the 3DR of the vessel of interest.

52. A method for three-dimensional reconstruction of a tubular organ, the tubular organ being imaged on two angiographic images, comprising:

extracting centerlines of the tubular organ on two angiographic images;

obtaining invariant functions of the two images;

constructing an optimization target function that is comprised of a penalty function expressing soft epi-polar constraint and discrepancies between invariant functions; the optimization's target function is defined over all possible correspondences between the two centerline points;

solving the optimization target function, to generate a map between 2D points on one centerline to the 2D points on the other centerline;

if a reference point is given, then optimizing solution so that the map includes the match of the reference point;

when a reference point is not given, finding it either by obeying the condition $E_1(i)=0$ and $E_2(j)=0$ where E is dP/dL, P is epi-polar distance and L is centerline length, or by means of finding the correlation of functions S_1/E_1 and S_2/E_2 expressed as functions of epi-polar distance to arbitrary temporary reference point or via correlation of functions R_1 and R_2;

wherein every matched set of 2D points defines a 3D point, for example as a point that minimizes distance from projective lines and the sequence of these 3D points is the three-dimensional reconstruction of the tubular organ.

53. The method according to claim 52, wherein invariant functions are comprised of radius or projected cross section area or centerline direction of the tubular organ along the centerline points, or the invariant function obtaining an invariant function from a tubular organ characteristic, the tubular organ being imaged in angiography, the invariant function being equivalence between the ratio of projected area and the visible epi-polar orientation for every pair of views..

54. The method according to claims 52, wherein a reference point is not given, and is found either by obeying the condition $E_1(i)=0$ and $E_2(j)=0$ where E is dP/dL, P is epi-polar distance and L is centerline length, or by means of finding the correlation of functions S_1/E_1 and S_2/E_2 expressed as functions of epi-polar distance to arbitrary temporary reference point or via correlation of functions R_1 and R_2..

55. The method according to claim 54, wherein the process of finding the correlation is performed prior to optimization..

56. The method according to claim 54, wherein the process of finding the correlation is performed as part of the optimization..

57. A method for three-dimensional reconstruction of an tubular organ, the tubular organ being imaged on three or more angiographic images, the method comprising forming a three-dimensional reconstruction of a tubular organ, the tubular organ being imaged on two angiographic images using the method according to any one of claim 56 and incorporating a direction correspondence criterion into the optimization process of said method..

58. The method according to Claim 57, wherein determining a 3D point includes "averaging" the 3D points that result from every pair of projection lines.

59. The method according to Claim 57, wherein determining a 3D point includes using three or more projection lines to determine a 3D point, for example, a point that minimizes sum of distances from those lines..

60. A method for automated three-dimensional reconstruction of a tubular organ from at least first, second and third angiographic projections, comprising:.

obtaining a three-dimensional (3D) reconstruction of the tubular organ from the first and second angiographic projections;

projecting the 3D reconstruction onto an image plane according to a specific viewing geometry of the third angiographic projection;

determining a shift between the third angiographic projection and the projected 3D reconstruction on said image plane so as to identify the tubular organ within the third angiographic projection;

tracing and analyzing the tubular organ in the third angiographic projection using the projected 3D reconstruction on said image plane as a first approximation so as to derive properties of the tubular organ; and

using said properties for re-determining the three-dimensional reconstruction to a better approximation.

61. The method according to claim 60, wherein projecting the 3D reconstruction onto an image plane produces a binary projected image.

62. The method according to claim 60, wherein projecting the 3D reconstruction onto an image plane produces a realistic projected image, in which a pixel's gray-level is a function of the length of intersection between the ray and the model.

63. A method for three-dimensional reconstruction from N (N>2) 2D projections, comprising:

obtaining a three-dimensional reconstruction for every pair of projections;

assigning a respective weight per 3D point, for each of said pairs of projections, that reflects a mutual geometry of two views and local orientation of a primary 3D model in such a way that maximal weight (1) is achieved by the combination of two orthogonal views, which are also both orthogonal to the organ; and such that the respective weight is near zero in the case when the two views are close to each other or if one of the views is too oblique; and

defining the reconstructed 3D point as a weighted sum of the intersection points per each pair of projective lines.

64. The method according to claim 63, wherein in assigning a respective weight per 3D point is performed by a weighting mechanism that utilizes the 3D model and viewing directions.